Question Number	Scheme	Marks
3(a)	$v = \dfrac{50}{2x+3}$	
	$\dfrac{\mathrm{d}v}{\mathrm{d}t} = \dfrac{\mathrm{d}v}{\mathrm{d}x} \times \dfrac{\mathrm{d}x}{\mathrm{d}t}$	M1
	$= \dfrac{-100}{(2x+3)^2} \times \dfrac{50}{2x+3} \quad \left(= \dfrac{-5000}{(2x+3)^3} \right)$	DM1A1
	$x = 12 \quad \dfrac{\mathrm{d}v}{\mathrm{d}t} = -\dfrac{5000}{27^3} = -0.2540... = -0.25$ or $-0.254\ \mathrm{m\,s^{-2}}$	M1
	deceleration $= 0.25\ (\mathrm{m\ s^{-2}})$ or better	A1 (5)
(b)	$v = \dfrac{\mathrm{d}x}{\mathrm{d}t} = \dfrac{50}{2x+3}$	M1
	$\int (2x+3)\,\mathrm{d}x = \int 50\,\mathrm{d}t$	
	$x^2 + 3x = 50t \ (+c)$	M1A1
	$t = 1,\ x = 4 \Rightarrow 28 = 50 + c,\ c = -22$	A1
	$x = 12 \Rightarrow 50t = 12^2 + 36 + 22 \quad t = \dfrac{202}{50} = 4.04$ (accept 4.0)	A1 (5)
		[10]

Notes

(a)

M1 Uses chain rule of the form $\dfrac{\mathrm{d}v}{\mathrm{d}t} = \dfrac{\mathrm{d}v}{\mathrm{d}x} \times \dfrac{\mathrm{d}x}{\mathrm{d}t}$ or $\dfrac{d(\frac{1}{2}v^2)}{dx}$

Note, $\dfrac{1}{2}v^2 = \dfrac{1250}{(2x+3)^2} \Rightarrow \text{acc} = \dfrac{d(\frac{1}{2}v^2)}{dx} = -\dfrac{2500}{(2x+3)^3} \times 2$

However, **M0** for acc = $\dfrac{1}{2}v^2$

DM1 Differentiate v wrt x

A1 Correct differentiation.

M1 Sub $x = 12$ into their expression for acceleration to obtain the deceleration. Must have attempted to differentiate.

A1 Correct deceleration – must be positive

(b)

M1 Use $v = \dfrac{\mathrm{d}x}{\mathrm{d}t}$

M1 Attempt at integration

A1 Correct integration but c may be missing

A1 Use $t = 1,\ x = 4$ to obtain the correct value of c for their correct integration

A1 Sub $x = 12$ to obtain the correct value of t

ALT 3(b)	Using definite integration: $\int_4^{12}(2x+3)\mathrm{dx}=\int_1^T 50\,\mathrm{dt}$
M1	Integrate $\left[x^2+3x\right]_4^{12}=\left[50t\right]_1^T$
A1	Correct integration
A1	Sub in limits $12^2+3(12)-4^2-3(4)=50T-50$
A1	Obtain correct value